

aluminium nitride or the like. On the film 12, formed is a spin valve device 13. The spin valve device 13 comprises a spin valve film 14, a pair of longitudinal bias films 15 and a pair of electrodes 16. The spin valve film 14 may be a bottom-type SV such as that in Example 4. Briefly, it comprises a nonmagnetic underlayer 141 of Ta, Nb, Zr, Hf or the like (thickness; 1 to 10 nanometers), an optional second underlayer 142 of Ru, NiFeCr or the like (thickness: 0.5 to 5 nanometers), an antiferromagnetic layer 143, a Synthetic pinned layer 144 of ferromagnetic layer/antiferromagnetically coupling layer/ferromagnetic layer, a nonmagnetic spacer 145, a free layer 146, a high-conductivity layer 147, and an optional protective film 148 (thickness: 0.5 to 10 nanometers). On the spin valve film 14, formed are an upper gap layer 17 (of alumina, aluminium nitride or the like), an upper shield layer 18 (of NiFe, a Co-based amorphous magnetic alloy, and an FeAlSi alloy or the like, having a thickness of from 0.5 to 3  $\mu\text{m}$ ). Though not shown, a recording part is formed thereover. The spin valve device 13 is of a so-called abutted junction type structure device, which is produced by removing the track edges of the spin valve film 14 followed by forming the longitudinal bias films in the removed sites. The longitudinal bias layers 15 may be of hard magnetic films (comprising CoPt, CoPtCr or the like as formed on a underlayer of Cr, FeCo or the like), or of laminates of a ferromagnetic layer 151 and an

antiferromagnetic layer 152 as laminated in that order, for which the ferromagnetic layer is hardened. For the laminates, the antiferromagnetic layer 152 may be formed first, and thereafter the ferromagnetic layer 151 is formed thereon. For producing steep reproduction sensitivity profiles at the track edges for the coming narrow-track devices, it is desirable that the magnetic thickness ratio of the longitudinal bias ferromagnetic layer (hard magnetic layer, or a combination of ferromagnetic layers as magnetically coupled to each other via an antiferromagnetic layer) to the free layer,  $M_{Sxt}(\text{longitudinal bias}) / M_{Sxt}(\text{free})$  is defined to be at most 7, more preferably at most 5. If the free layer is so thinned that its thickness is not larger than 4.5 nanometers (therefore having a magnetic thickness of at most 5 nanometer Tesla), the longitudinal bias ferromagnetic layer shall be also thinned (to have a magnetic thickness of at most 25 nanometer Tesla) so as to satisfy the condition of  $M_{Sxt}(\text{longitudinal bias}) / M_{Sxt}(\text{free}) \leq 5$ .

In general, thin hard magnetic layers could hardly have high coercive force. On the other hand, longitudinal bias layers of the type of ferromagnetic film/antiferromagnetic film could be more firmly coupled when the ferromagnetic layer 151 is thinner, since the magnetic coupling bias field is enlarged. Therefore, longitudinal bias layers of the type of ferromagnetic film 151/antiferromagnetic layer 152 are

preferred. More preferably, in the longitudinal bias layers of the type of ferromagnetic layer 151/antiferromagnetic layer 152, the saturation magnetization of the ferromagnetic layer 151 is nearly comparable to or higher than that of the free layer for the purpose of realizing complete BHN (Barkhausen noise) removal in a smallest possible longitudinal bias magnetic field. For this, NiFe alloys may be used, but more preferred are CoFe, Co and the like having larger saturation magnetization. If the ferromagnetic film 151 used has small saturation magnetization and if the stray magnetic field is enlarged by increasing the thickness of the film 151 for realizing BHN removal, such will cause reproduction output reduction especially in narrow tracks.

In the case of Fig. 50, the spin valve film 14 is not completely etched but the antiferromagnetic layer 143 is left as it is to form the longitudinal bias layers. Apart from this case, even the underlayer 141 may be etched away. Forming the longitudinal layers 15 on the remaining antiferromagnetic layer 143 is advantageous in that the electrical contact between the longitudinal bias layers and the spin valve film is good. In an ordinary abutted junction structure where the length of the electrode 16 is nearly the same as that of the longitudinal bias layer 15, the electrode could not keep direct face contact with the spin valve film. In that case, therefore, the merit of the remaining antiferromagnetic film 143 is great.